Exploring Frontiers in Neurological Imaging

3.0T MR Brings New Capabilities and Abundant Potential for University of Wisconsin-Madison Hospitals and Clinics

Patrick Turski, M.D., has worked on the forefront of MR imaging since its emergence in clinical practice. Today, he sees significant benefits and a highly promising future in neurological imaging with the latest 3.0T MR imaging platform.

As a neuroradiologist in the Department of Radiology with the University of Wisconsin-Madison Hospitals and Clinics, Dr. Turski has worked with GE Signa® 3.0T MR systems since late 2004.

Among its benefits, Dr. Turski and his colleagues note the higher signal strength of 3.0T enhances visualization of small structures in the brain, improve time-of-flight MRA studies and differentiation of the meninges and ventricular linings. The technology also facilitates the use of parallel imaging to acquire 3D brain images, which enable highly detailed brain analyses.

From the Beginning

Dr. Turski's experience with GE MR technology goes back more than 20 years. In late 2004, University of Wisconsin-Madison Hospitals and Clinics installed two 3.0T systems – one at the main hospital campus in Madison, primarily for neurology, and a second at an affiliated sports medicine center, mainly for musculoskeletal studies.

"For neurological applications, there are some definite advantages to 3.0T as compared to 1.5T," Dr. Turski said. "There is a significant increase in signal-to-noise ratio (SNR), and we're able to take advantage of that by either imaging at a higher resolution or by speeding up acquisitions to reduce imaging time" (Figure 1).

The higher resolution also enables better detection of some common brain disorders. "3.0T is a very good platform for neurological imaging in general," Dr. Turski noted. "We like to have the highest-resolution imaging possible for certain diseases, such as epilepsy patients who have abnormalities of the temporal lobe.

"Some structures in the temporal lobe are quite small. The hippocampal formation, for example, is difficult to image at 1.5T. It's still a challenge to image at 3.0T, but the additional signal-to-noise helps us to push the resolution and enables us to see the hippocampal structures a little better."

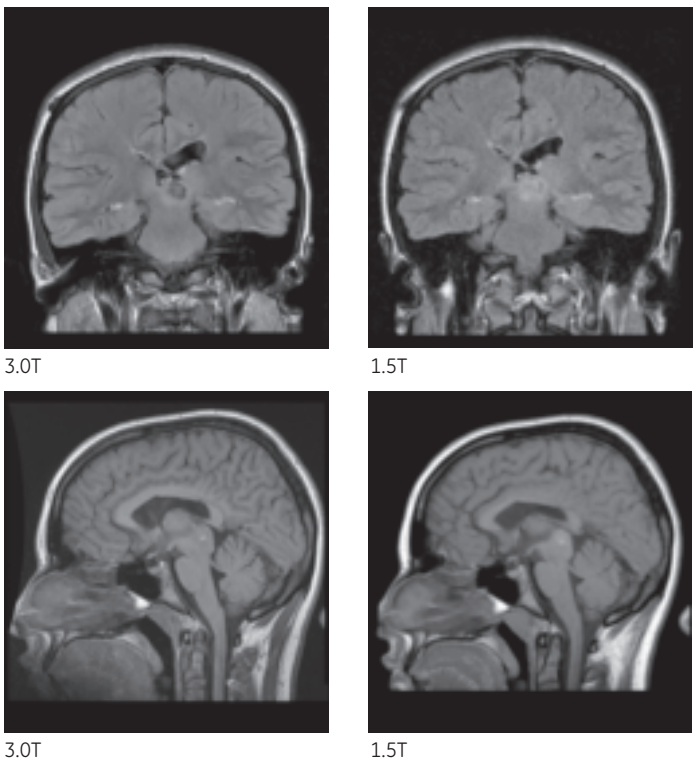
Improving Applications

Dr. Turski finds 3.0T MR beneficial for a variety of imaging procedures and protocols.

MR angiography (MRA): 3.0T speeds up acquisitions and the advanced TRICKS™ angiography application enables greater arterial information through faster frame rate. "We like to see arterial structures in great detail," Turski said. "By having more arterial frames, we can capture the peak of the contrast bolus. That gives us information about the dynamics of flow through the arterial system. We can see if the flow is faster in one artery and slower in another, and if so, that usually indicates some disease involving that blood vessel."

Time-of-flight imaging: "For some applications, such as 3D time-of-flight MRA, 3.0T is a favorable field strength," Dr. Turski noted. "It prolongs the T1 times and that makes the background signal intensity a little lower. So we've seen a significant improvement in 3D time-of-flight imaging – and that has been substantiated at other sites and reported in the literature."

3D imaging: The 3.0T technology helps overcome the signal-to-noise penalty inherent in ASSET parallel imaging, Turski observed. "The combination of higher field and parallel imaging is one reason we bought a 3.0T system," he explained. "We can do 3D imaging four times faster and with signal-to-noise equivalent to or better than at 1.5T. As a result, we have thinner sections and we can post-process the information to perform volumetric measurements. We can then slice the brain in any direction and sub-segment parts of the brain to look at them in detail. We can also co-register the MR images with PET exams or 3D CT exams."



3.0T 1.5T

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Figure 1. A 16-year-old patient presenting with double vision on upward gaze. Note that the 3.0T images have improved resolution and increased SNR. Diagnosis: Tectal Glioma

Patrick Turski, M.D.

Patrick Turski, M.D., is a Neuroradiologist, Department of Radiology, at the University of Wisconsin-Madison Hospitals and Clinics.

About the University of Wisconsin-Madison

UW Health, the academic health system for the University of Wisconsin, offers more than 60 locations throughout the state, including the renowned University of Wisconsin Hospital and Clinics and University of Wisconsin Children's Hospital in Madison. This comprehensive system of health-care providers serves patients at more than 60 clinical locations throughout the state.

University of Wisconsin Hospital and Clinics is a 471-bed facility that ranks among the finest academic medical centers in the United States. Frequently cited in publications listing the nation's best healthcare providers, University of Wisconsin Hospital and Clinics is recognized as a national leader in fields such as cancer treatment, pediatrics, ophthalmology, surgical specialties and organ transplantation.

The University of Wisconsin Hospital and Clinics offers more than 800 active medical staff and more than 80 outpatient clinics. The hospital has six intensive care units (trauma and life support, pediatric, cardiac, cardio-thoracic, burn, neurosurgery) with 74 total beds, and is one of only two organizations in Wisconsin with designated Level One adult and pediatric trauma centers.

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Dr. Patrick Turski

Diffusion-weighted imaging: Dr. Turski and colleagues use diffusion-weighted imaging (DWI) routinely and find it valuable for studying a variety of neurological conditions.

FLAIR imaging: "FLAIR is extremely useful in neurological diseases," Dr. Turski said. "This is one area where we see a marked difference between a 3.0T and 1.5T platform. FLAIR imaging provides very good contrast between a large variety of pathologies, the brain tissue and the spinal fluid.

"In FLAIR, the signal from the cerebrospinal fluid is suppressed, and so we have a very dark background for observing diseases that involve the edges of the ventricles, such as ventriculitis. We also get a very good look at the meninges. These areas, although visible on T1-weighted images with contrast, are much more distinctive in FLAIR images. That means we can pick up diseases at an earlier stage and diagnose with greater confidence.

"T1 FLAIR images on 3.0T are spectacular. We get excellent gray-white differentiation, which enables us to see whether an area of the brain is atrophic or whether there has been some loss of brain volume. In the hippocampal region, we use T1 weighting extensively to see the morphology of that formation."

Dr. Turski also finds T2 FLAIR imaging with contrast is "extremely useful" for visualizing tumors and edema in cancer patients (Figure 2).

Looking Ahead

In Dr. Turski's view, 3.0T technology provides a competitive edge over other MR scanners. "If you are able to show benefits to referring physicians, such as higher-resolution images of the temporal lobe and better time-of-flight imaging when compared to 1.5T, that does give you an advantage."

He expects 3.0T technology to become more prevalent as new coils and applications begin to harness its full potential. He notes perfusion and functional MRI studies in the brain, as well as spinal and musculoskeletal imaging are key areas to watch for major advances. ■

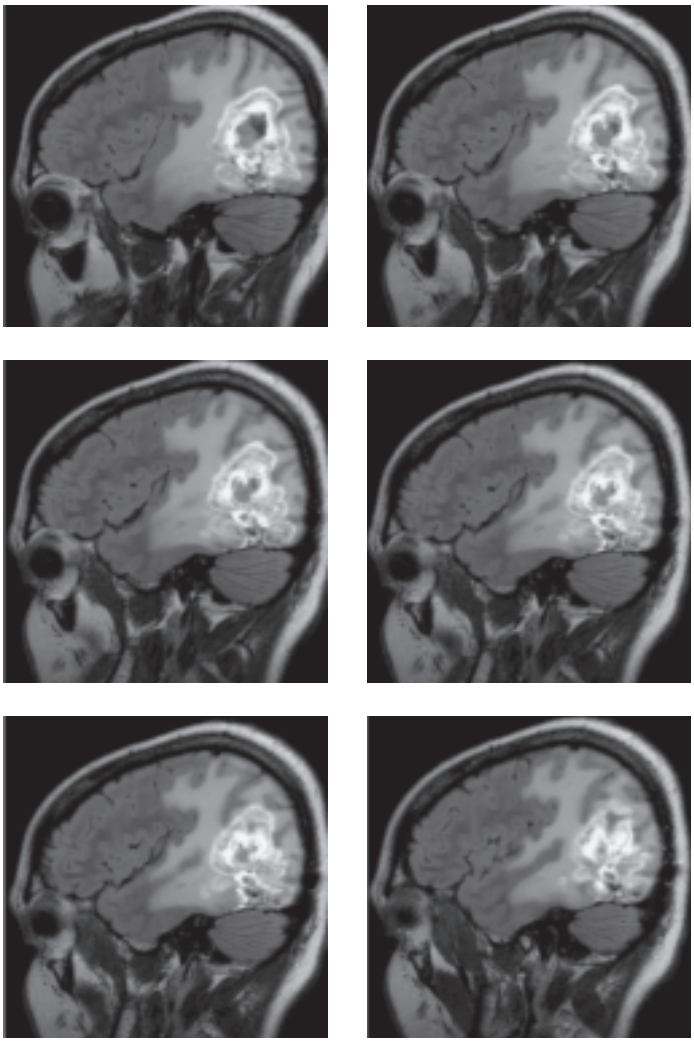

Figure 2. The 3D XETA FLAIR images were obtained using parallel imaging (ACR). Six images from a 128 images acquisition are displayed. The voxels are isotropic and the image information can be reformatted into any plane, co-registered to other 3D datasets and used for volumetric measurements or representations of the surface anatomy.